

### **REMARKS**

Claims 6, 7 and 20-22 were pending in the present application. Claims 6, 7, 21, and 22 have been amended. Claims 23-52 have been added. No claims have been cancelled. Therefore, claims 6, 7, and 20-52 are pending in the present application. Support for the claim amendments and the new claims can be found in the specification and in the original claims. Accordingly, Applicants respectfully submit that no new matter has been added.

Applicants believe that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested in view of the above amendments, and for the reasons which follow.

#### **Claim Rejections Under 35 U.S.C. § 112, second paragraph**

In the Office Action, claims 6, 7 and 20-22 were rejected under 35 U.S.C. § 112, second paragraph as being indefinite. Applicants have amended claims 6 and 7 to address this issue. Accordingly, Applicants respectfully request reconsideration of these rejections.

#### **Doctrine of Obviousness-Type Double Patenting**

Claims 6, 7, and 20-22 are rejected under the judicially created doctrine of obviousness-type double patenting in view of claims 1-5 of Patent No. 6,106,791. The office action concedes that the claims are not identical, but argues that the claims are not patentably distinct from each other because the claims encompass the patented treatment temperatures.

Applicants respectfully submit that the rejection of obviousness-type double patenting is improper for at least the reason that the claims of the '791 patent are directed to a process for removing nitrogen oxides whereas the claims of the present application are directed to removal of sulfur from a gaseous stream. Applicants request that the rejection of obviousness-type double patenting be withdrawn.

#### **Claim Rejections Under 35 U.S.C. § 103(a)**

In the Office Action, claims 6 and 7 were rejected under 35 U.S.C. § 103 as being unpatentable over Ninomiya et al. taken with Japan '176, and also as unpatentable over

Hamada et al. taken with Japan '176. In reply, Applicants traverse the rejections and, at the outset, direct the Examiner to MPEP § 2143, which states that:

[t]o establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

It is respectfully submitted that the office action has not met at least the first and third criteria set out in MPEP § 2143.

Lack of Suggestion or Motivation to Modify or Combine the References

Claims 6 and 7 both contain the limitation of the use of active carbon fiber in a desulfurization process. Ninomiya does indeed teach utilizing activated carbon for removal of sulfur oxide from waste gases. However, Ninomiya teaches that this is accomplished by utilizing activated carbons having surface areas of 200 m<sup>2</sup>/g and 2,000 m<sup>2</sup>/g, ranges which can be achieved in “an optional shape such as granular, crushed or powdery form.” (column 3, lines 21-24) Ninomiya is silent in regard to the utilization of different forms of activated carbon other than that disclosed, and, as such, is silent in regard to the utilization of active carbon *fiber*, as is claimed in the present invention. Indeed, by only listing “spherical” forms of carbon, Ninomiya teaches away from the present invention. Therefore, it would not be obvious to one of ordinary skill in the art to look to a reference such as Japan '176 utilizing carbon fiber to practice Ninomiya.

The office action states that it would have been obvious to use the '176 fibers in the process of Ninomiya because fibers have a higher surface area per gram than spherical particles, thus making the process more efficient. It is respectfully submitted that there are many instances in the pollution control arts where the highest efficiency is not desirable. For example, a catalyst with the highest rate of activity may not be desirable because the catalyst may be exhausted too quickly, thus diminishing the catalyst's industrial usefulness.

Conversely, it is not entirely accurate that fibers always have a higher surface area than spherical particles. From the volumetric and surface equations of a sphere

$$V = 4/3 \pi r^3 \quad A = 4 \pi r^2$$

it can be seen that the volume of a sphere decreases one order of magnitude *faster* than the surface area of sphere, thus meaning that for tiny particles, such as would be found in “granular, crushed or powdery form,” the sphere provides a tremendous amount of surface area (which are, as noted, envisioned in Ninomiya). Moreover, there is a limit as to how small one can make a fiber (thus meaning that there is a limit as to how far one can increase a surface area for a given volume), because a fiber needs a certain amount of structural strength, while there is no need for structural strength for a substance in a granular, crushed or powdery form. Thus, the size of the latter can be reduced to a few orders of magnitude above the molecular level. In sum, a *prima facie* case has not been established that the carbon fiber of ’176 can be used in Ninomiya, thus the rejection is improper for at least the above reasons.

However, assuming *arguendo* that it would have been obvious to practice Ninomiya utilizing fibers, it would still not be obvious to one of ordinary skill in the art to combine Ninomiya with Japan ’176. While Japan ’176 teaches the use of an active carbon fiber, it is directed solely at reducing nitrogen monoxide; the reference is silent in regard to use in desulfurization, as its title indicates. Thus, one of ordinary skill in the art searching for a desulfurization process would not look to ’176, and thus would not combine ’176 with Ninomiya.

It is noted here that the claims of the present invention allow for an exhaust gas treating system that can treat exhaust gas at low temperatures, thus eliminating the need for a heater to heat the gas. It is noted that Ninomiya calls for the heating of the gas prior to subjecting the activated carbon to the gas. (column 4, lines 40-55) Thus, one of ordinary skill in the art searching for a desulfurization process that does not require the preheating of the gas would not look towards Ninomiya, and in fact would be discouraged from using Ninomiya. It is further noted that the claims of the present invention do not require the presence of ammonia near the activated carbon, as is required by Ninomiya. (column 2, lines

7-11) Indeed, the exposure of ammonia to the activated carbon is the crux of Ninomiya's process. This is simply yet another reason why one of ordinary skill in the art would not look to Ninomiya for teachings or suggestions to practice the present invention, but there are still more reasons. Claims 6 and 7 of the present invention result in active carbon fibers having hydrophobic surfaces. Conversely, the activated carbon of Ninomiya utilizes hydrophilic surfaces. It is well known in the art that hydrophilic functional groups containing oxygen are often present at the surface of activated carbon, and, unlike the process claimed in claims 6 and 7, Ninomiya does not teach a step that leads to the removal of such compounds as CO and CO<sub>2</sub> (hydrophilic functional groups), and, in fact, teaches the introduction of such groups containing oxygen into the carbon. This is seen at column 3, lines 50-55 and lines 65-68 and column 4 lines 1-26 of Ninomiya. Indeed, immersing the activated carbon in sulfuric acid treatment does nothing to reduce the hydrophilic functional groups. Since Ninomiya teaches the use of hydrophilic surfaces, Ninomiya teaches away from the present invention. Thus, one of ordinary skill would not look to Ninomiya for combination with '176 to practice the present invention.

Because of the lack of suggestion or motivation to modify or combine the Ninomiya with '176, the first requirement of MPEP § 2143 has not been met and, hence, a *prima facie* case of obviousness has not been established against the claims deemed obvious in light of Ninomiya and '176.

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In regard to the combination of Hamada with Japan '176, the deficiencies of '176 discussed above in regard to the present invention are equally as valid as applied against the Ninomiya and '176 combination and are likewise relied upon in traversing the rejection based on Hamada and '176, but will not be repeated here in the interest of brevity.

As note above, claims 6 and 7 both contain the limitation of the use of active carbon fiber in a desulfurization process. Hamada does indeed teach utilizing activated carbon for removal of sulfur oxide from waste gases. However, Hamada teaches that this is accomplished utilizing "absorbent granules." (column 5, lines 58-64 and column 7, line 7)

Hamada is silent in regard to the utilization of different forms of activated carbon other than that disclosed, and, as such, is silent in regard to the utilization of active carbon *fiber*, as is claimed in the present invention. Thus, just as with Ninomiya, Hamada, by only listing “spherical” forms of carbon, actually teaches away from the present invention. Therefore, it would not be obvious to one of ordinary skill in the art to look to a reference utilizing carbon fiber such as '176 to practice Hamada. That is, Hamada suffers from the same deficiencies as Ninomiya.

The office action states that it would have been obvious to use the '176 fibers in the process of Hamada because fibers have a higher surface area per gram than spherical particles, thus making the process more efficient. It is respectfully submitted that the above arguments against there being obviousness in this regard are applicable here, and, in the interest of brevity, the above arguments are not repeated.

However, assuming *arguendo* that it would have been obvious to practice Hamada utilizing fibers, it would still not be obvious to one of ordinary skill in the art to combine Hamada with Japan '176. While Japan '176 teaches the use of an active carbon fiber, it is directed solely at reducing nitrogen monoxide; the reference is silent in regard to use in desulfurization, as its title indicates. Thus, one of ordinary skill in the art searching for a desulfurization process would not look to '176, and thus would not combine '176 with Hamada.

As noted above, the claims of the present invention allow for an exhaust gas treating system which can treat exhaust gas at low temperatures, thus eliminating the need for a heater to heat the gas. It is noted that Hamada relies on a preheater to heat the gas prior to subjecting the activated carbon to the gas. (column 3, lines 66-67) Thus, one of ordinary skill in the art searching for a desulfurization process that would eliminate the need for the preheating of the gas would not look towards Hamada, and in fact would be discouraged from using Hamada. It is further noted that the claims of the present invention do not require the addition of ammonia near the activated carbon, as is required by Hamada. (column 3, line 12; column 3, lines 17-43) So critical is the addition of ammonia in Hamada that an ammonia limitation is present in each claim. This is simply yet another reason why one of ordinary

skill in the art would not look to Hamada for teachings or suggestions to practice the present invention, but there are still more reasons. Claims 6 and 7 of the present invention result in active carbon fibers having hydrophobic surfaces. Conversely, the activated carbon of Hamada utilizes hydrophilic surfaces. It is well known in the art that hydrophilic functional groups containing oxygen are often present at the surface of activated carbon, and, unlike the process claimed in claims 6 and 7, Hamada does not teach a step that leads to the removal of such compounds as CO and CO<sub>2</sub> (hydrophilic functional groups). Thus, one of ordinary skill would not look to Hamada for combination with '176 to practice the present invention.

Because of the lack of suggestion or motivation to modify or combine the Hamada with '176, the first requirement of MPEP § 2143 has not been met and, hence, a *prima facie* case of obviousness has not been established against the claims deemed obvious in light of Hamada and '176.

#### The References Do Not Suggest All Claim Recitations

Even if the first requirement of MPEP § 2143 is satisfied in the office action in regard to the combination of Ninomiya and Japan '176 and the combination of Hamada and Japan '176, the cited references still would not meet the third requirement, which is that “the prior art reference (or references when combined) must teach or suggest all the claim limitations.”

Claim 6 prescribes a desulfurization process which comprises bringing a gas containing SO<sub>2</sub>, water, and oxygen in contact with a carbon fiber. As noted above, '176 is silent in regard to a gas other than nitrogen based gasses, and is, as such, is silent in regard to SO<sub>2</sub>, water, and oxygen. While it is true that Ninomiya and Hamada teach bringing a gas containing SO<sub>2</sub> in contact with activated carbon, these references are silent in regard to bringing a gas containing water or oxygen into contact with the activated carbon. Further, in analyzing the limitation of a gas containing water, both references teach away from the present invention. In Ninomiya's patent, he considers gas containing water to be subversive to his process: The absorption process “is accompanied by such drawbacks . . . its adsorptive capacity is considerably reduced by water vapor which may be contained in the gas.”

(column 1, lines 55-60) From Hamada's title "Method of Removing Sulfur Oxides and Nitrogen Oxides by *Dry Process*" (emphasis added), the absence of the presence of water in the Hamada method is an important feature; an important enough feature to be included in the title of the patent. Since Ninomiya, Hamada, and '176 do not disclose, teach, or suggest, separately or together, bringing a gas containing water and/or oxygen in contact with carbon fibers, each and every element of claim 6 is not found in the references.

Claim 7 claims a desulfurization process where a heat-treated active carbon fiber is positioned on the downstream side of a desulfurization apparatus based on the lime-gypsum method. Ninomiya, Hamada, and Japan '176 are silent in regard to the lime-gypsum method. Thus, these claims are allowable since none of the cited references, alone or in combination, disclose, teach, or suggest, utilization of heat treated active carbon fiber with an apparatus based on the lime-gypsum method.

In sum, the rejection of claims 6 and 7 are traversed because the cited references do not suggest each and every element of the claims. Claims 20-22 are allowable for at least the reason that the claims depend from claims 6 or 7. Further, claims 21 and 22 contain the limitation that the starting active carbon fiber is a polyacrylonitrile-based starting active carbon fiber. The limitations of these claims are not addressed in the office action. This is not surprising, as the polyacrylonitrile-based starting active carbon fiber limitation is not present in the cited references. Thus, claims 6-7 and 20-22 are allowable.

#### New Claims

New claims 23 and 24 are copies of pre-amended claims 21 and 22, except that the limitation of these claims is solely directed to a starting active carbon fiber that is a pitch-based starting active carbon fiber. That is, the alternate limitation of polyacrylonitrile-based starting active carbon fiber (in pre-amended claims 21 and 22) is not present. Applicants submit that new claims 23 and 24 are allowable because Ninomiya, Hamada, and Japan '176 are silent in regard to the pitch-based starting active carbon fiber. These limitations, which were present in pre-amended claims 21 and 22, are not addressed in the office action. This is

not surprising, as the pitch-based starting active carbon fiber limitation is not present in the cited references. Thus, these new claims are allowable.

Applicants have also added a series of new claims to further differentiate the invention from the cited references. These new claims either contain the limitations of claim 6 or claim 7, and thus are allowable for at least the reason that claims 6 and 7 are allowable. However, the Examiner is invited to review the newly added independent claims in view of the cited prior art to verify that these claims do indeed contain the limitations of claim 6 or claim 7.

### Conclusion

Applicants believe that the present application is in condition for allowance. Entry of the present claim revisions and favorable reconsideration are requested. The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance prosecution. A ONE MONTH petition for an extension of time is submitted herewith. If the Applicants have not accounted for any fees required by this Amendment, the Commissioner is hereby authorized to charge to our Deposit Account No. 19-0741. If applicants have not accounted for a required extension of time under 37 C.F.R. § 1.136, that extension is requested and the corresponding fee should be charged to the deposit account.

Respectfully submitted,

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By

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**Version with Markings to Show Changes Made (Claims)**

6. (twice amended) A desulfurization process which comprises bringing a gas containing SO<sub>2</sub>, water, and oxygen into contact with a heat-treated active carbon fiber ~~for use in desulfurization~~ wherein said heat-treated active carbon fiber has been obtained by heat-treating a starting active carbon in a non-oxidizing atmosphere, wherein said starting active carbon is a starting active carbon fiber.

7. (twice amended) A high depth desulfurization process which comprises removing sulfur oxides by using a heat-treated active carbon fiber ~~for use in desulfurization~~, wherein said heat-treated active carbon fiber has been obtained by heat-treating a starting active carbon in a non-oxidizing atmosphere, wherein said heat-treating comprises heating at a temperature of 600 to 1,200° C in a non-oxidizing atmosphere, on the downstream side of a desulfurization apparatus based on the lime-gypsum method.

21. (amended) The process of claim 6, wherein said starting active carbon fiber is a polyacrylonitrile-based ~~or pitch-based~~ starting active carbon fiber.

22. (amended) The process of claim 7, wherein said starting active carbon fiber is a polyacrylonitrile-based ~~or pitch-based~~ starting active carbon fiber.